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Patentanmeldung Nr. Patent application No. Demande de brevet n°

02023505.7

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

R C van Dijk

Anmeldung Nr:
Application no.: 02023505.7
Demande no:

Anmeldetag:
Date of filing: 22.10.02
Date de dépôt:

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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
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Electrical connector with a locking ring, especially a coaxial plug

In Anspruch genommene Priorität(en) / Priority(ies) claimed /Priorité(s) revendiquée(s)
Staat/Tag/Aktenzeichen/State/Date/File no./Pays/Date/Numéro de dépôt:

Internationale Patentklassifikation/International Patent Classification/
Classification internationale des brevets:

H01R/

Am Anmeldetag benannte Vertragstaaten/Contracting states designated at date of filing/Etats contractants désignées lors du dépôt:

AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SK TR

Description

Electrical connector with a locking ring, especially a coaxial plug

The invention relates to an electrical connector with a locking ring according to claim 1.

Axially mating electrical connectors comprise a first connector member having a first contact therein, a second connector member having a second contact for electrical connection with the first contact upon mating of said first and second connector member. Said second connector member includes a cylindrical body. Said first connector member comprises an axial bore for receiving said cylindrical body in a mounted position. Said cylindrical body or said bore comprises a groove. Between the body and the bore a locking ring with latching fingers is arranged, whereby the fingers are engaged with the groove and the ring is engaged with the first or with the second connector member, respectively. In this way the first and the second connector member are prevented from disengagement. The purpose of the locking ring is to lock. Therefore the fingers have to show a suitable length and a suitable angle at which the fingers are positioned. To guarantee an axial locking with a very small clearance, it is necessary that the diameter of the bore and the diameter of the body and respectively the length and the angle of the fingers are within a small range of values. This causes high production costs. The patent DE 197 49 130 C1 describes such an axially mating electrical connector with a locking ring.

It is an object of the present invention to provide an electrical connector that reduces an axial movement of a first and second contact member, even in the case of high production tolerances.

The object of the present invention is attained by an electrical connector according to claim 1.

According to this aspect of the present invention, an electrical connector is provided comprising a first contact member having a first contact therein. The first contact is provided for electrical connection with a second contact of a second contact member in a mated position of the first and the second contact member. Said first contact member includes a body and said first contact member comprises an opening receiving said body in the mated position.

Said body or said bore comprises a groove at an outer or an inner side, respectively. A locking ring with latching fingers is arranged between the first and the second contact member, whereby the fingers are engaged with the groove, and the locking ring is fastened with the first or with the second contact member, respectively, locking the first and second contact member in the mated position. At least two fingers of the ring show different lengths. Providing fingers with different lengths has the advantage that the first and second contact member could be locked in a predetermined axial position to each other although the body and/or the bore and/or the groove differ from optimal size or position. The deviation of the optimal size or the optimal position of the groove will be compensated by the different lengths of the fingers. Depending on the situation, the longer or the smaller or all two types of fingers engage with the groove.

In a preferred embodiment of the invention the fingers with different lengths are inclined towards the plane of the ring at different angles. This has the advantage that the different lengths of the fingers can be more efficiently used for locking the body.

The axial locking of the cylindrical body is improved by providing pairs of fingers which are arranged at opposite sides

of the ring, whereby the fingers of one pair are of the same length. This embodiment has the advantage that a body is held against an axial movement by fingers that show the same length at opposite sides. Furthermore the first contact member comprises a stop plane, at which the second contact member is held in the mated position. In this embodiment the different lengths of the fingers are used for improving the locking of the second contact member in the mated position, whereby the second contact member is held against the stop plane. Depending on the position of the groove, all types of fingers or only the shorter ones are engaged with the groove. The second member is always held against the stop shoulder. This shows the advantage that the axial position of the second and the first contact member is always the same, causing the same electrical property of the mated contact members.

It is of particular advantage for coaxial connectors that always the second contact of a second coaxial connector is held against the stop plane of the first coaxial connector. The coaxial connectors are shaped in such a way that the connection between the two coaxial connectors shows at this position preferred electrical properties especially for the behavior of high frequency signals.

An improved locking of the body is attained by providing fingers that have a shorter length and that are arranged to the plane of the ring at a smaller angle than the fingers with a longer length. This embodiment improves holding the second contact member against the first contact member although there are production ranges i.e. for the position of the groove.

A greater flexibility for axial locking is attained by providing a locking ring with three types of fingers with three different lengths. The three types of fingers are arranged with three different angles to the plane of the ring. This embodiment provides a locking with a little clearance of the

second contact member against the first contact member although the axial position of the groove varies within a broader range of value. Depending on the axial position of the groove at least one type of fingers is engaged with the groove.

Brief description of the drawings

Fig. 1 is a partial longitudinal sectional view of the connector of the present invention showing the first and the second contact member in a mated position;

Fig. 2 shows a sectional view of the first contact member comprising a movable unlocking sleeve;

Fig. 3 shows in detail an inner sleeve and latching fingers;

Fig. 4 shows the movable unlocking sleeve of the first contact member;

Fig. 5 shows a partial longitudinal sectional view of the second contact member;

Fig. 6 shows the ring with the fingers, whereby the fingers are of different length and are arranged with different angles to the plane of the ring;

Fig. 7 shows the ring from an upper side;

Fig. 8 shows a sectional view of the ring;

Fig. 9 shows a schematic view of the mated position of the first and second contact member, whereby a stopping plane is depicted as a line to which the second contact member is held. Three types of fingers and a corresponding groove are depicted, whereby the fingers are shown in one plane although

they are really positioned at different positions around the ring;

Fig. 10 shows the ring and the corresponding groove, whereby, compared to Fig 9, the groove is arranged at a greater distance to the end face of the second sleeve;

Fig. 11 shows an embodiment with the ring and the groove, whereby, compared to the embodiment of Fig. 10, the groove is arranged at a greater distance from the ending of the second sleeve.

Description of the preferred embodiment

Referring now to the drawings in detail, in Fig. 1 a connector system with a first contact member 2 and a second contact member 3 is shown. For the connection between the first and the second contact member 2, 3 a locking ring 1 with latching fingers 6 is provided. The ring 1 is locked with a sleeve body 24 of the first contact member 2. In an opening 13 of the sleeve body 24 a first sleeve 7 of the first contact member 2 is arranged. The first sleeve 7 shows in a sectional view the form of a circle. A contacting pin 25 is arranged in the center of the circle. The contacting pin 25 constitutes a part of the first contact member 2. The contacting pin 25 is inserted into a contacting sleeve 22 that constitutes a part of the second contacting member 3. The contacting pin 25 and the contacting sleeve 22 are electrically connected. The first sleeve 7 and the contacting pin 25 are electrically isolated and can be used for conducting different potentials. In a preferred embodiment, the first sleeve 7 is used as a shielding for the signals of the contacting pin 25.

The contacting sleeve 22 is surrounded by a second sleeve 27 that is also part of the second contact member 3. The contacting sleeve 22 and the second sleeve 27 are electrically isolated. The first sleeve 7 is inserted into the second

sleeve 27 and is electrically connected with the second sleeve 27. An ending of the second sleeve 27 is adjacent to a stop plane 14 of the first contact member 2. The stop plane 14 could be realized as a rim or a bended rim of a stop sleeve or a rim of a spring. The stop sleeve or the spring are fixed with the sleeve body 24. The axial position of the first contact member 2 relative to the second contact member 3 is important, because the electrical impedance of the connection of the first and the second contact member 2,3 depends on their axial position to each other. The first and the second contact member 2, 3 are designed to have the best impedance if the second contact member 3, especially the second sleeve 27 is adjacent to the stopping plane 14 of the first contact member 2. The locking ring 1 with the latching fingers 6 holds the second contact member 3 against the stop plane 14.

At a predetermined distance from a front end of the second sleeve 27 that is adjacent to the stop plane 14, an annular groove 4 is provided at an outer side of the second sleeve 27. The latching fingers 6 are engaged with the groove 4 in a mated position of the first and second contact member. The latching fingers 6 hold the second sleeve 27 at the stop plane 14. Therefore the second contact member 3 is held at an axial position to the first contact member 2 that is most suitable for the impedance of the electrical connection between the first and the second contact member 2, 3.

The locking ring 1 has the further function of locking the first with the second contact member 2, 3 in the mated position. If the second contact member 3 is drawn off the first contact member 2, the groove 4 is pushed against the latching fingers 6 that are stiff and retained by the locking ring 1. The latching fingers 6 prevent the second contact member 3 from being drawn off the first contact member 2.

The sleeve body 24 is surrounded by an outer sleeve 29 that is part of an unlocking member 28. The unlocking member 28 also comprises an inner sleeve 30 that is arranged in parallel to the outer sleeve 29 . Within the inner sleeve 30 a cylindrical opening is arranged for receiving the second sleeve 27, if the second contact member 3 is plugged into the first contact member 2 in the mated position. The diameter of the inner sleeve 30 is smaller than the diameter of the locking ring 1 but greater than the distance of two opposite latching fingers 6. The inner sleeve 30 is arranged in a mated position in front of the latching fingers 6. The unlocking member 28 comprises an annular receiving chamber 40 that is positioned between the inner and the outer sleeve 30, 29 and open in the direction of the sleeve body 24. The receiving chamber 40 is used for receiving a front part of the sleeve body 24. The unlocking member 28 can be moved along the longitudinal axis of the sleeve body 24. For unlocking the connection between the second contact member 3 and the first contact member 2 the unlocking member 28 is pushed into the direction of the sleeve body 24. By pushing the unlocking member 28 to the sleeve body 24, a front part of the sleeve body 24 is moved in the receiving chamber 40. As a result of this movement the inner sleeve 30 pushes the latching fingers 6 outwards. The latching fingers 6 are moved out of the groove 4. The latching fingers 6 release the second sleeve 27 for an axial movement. Therefore the second sleeve 27 can be drawn out of the sleeve body 24 disengaging the first and the second contact member 2, 3.

Fig. 2 shows a longitudinal sectional view of an electrical connector with the first contact member 2, which is connected with a cable 32. The cable 32 comprises a central conductor 8 which is connected with the contacting pin 25. The central conductor 8 is surrounded by an annular insulator 11. The dielectric insulator 11 is surrounded by an outer conductor 9. The outer conductor 9 is electrically connected with the first sleeve 7. The first contact member 2 is realized in

this embodiment as a coaxial connector plug and the second contact member 3 is realized in this embodiment as a coaxial jack. The invention is not limited to the shown embodiments and can also be used for other kinds of contact members.

As shown in Fig. 2, the sleeve body 24 comprises a stop sleeve made of metal with a bent rim 12 at a front end that is bent on the inside in the direction of the first sleeve 7. Between the front end of the sleeve body 24 and the bent rim 12 the ring 1 is arranged. The distance between the front end of the sleeve body 24 and the rim 12 may be greater than the height of the ring 1 providing a little clearance for the ring in an axial direction.

As it is shown in Fig. 3, the inner sleeve 30 comprises an annular flange 41 that is inclined in the direction of the latching fingers 6 from an outer to an inner side. The annular flange 41 supports the latching fingers 6 being pushed outwards by moving the opening sleeve 28 to the sleeve body 24.

Fig. 4 shows the unlocking member 28 in detail. The unlocking member 28 comprises a central opening 15 that is surrounded by the inner sleeve 30. The inner and the outer sleeve 30, 29 are connected over a ring part 42, that is arranged at the front of the unlocking member 28. The ring part 42 comprises a conical flange 20 at a front side. The conical flange 20 is inclined towards the central opening 15. The inner and the outer sleeve 30, 29 are arranged in parallel.

Fig. 5 shows the second contact member 3 with the contacting sleeve 22 that is surrounded by a second annular insulator 21. The second annular insulator 21 is surrounded by a second outer conductor 43 that is electrically connected with the second sleeve 27.

Figs. 6 to 8 show different views of the locking ring 1 with the latching fingers 6. The latching fingers 6 are positioned at an inner side of the locking ring 1. In comparison to a plane that is defined by the ring 1 as shown in Fig. 6, the latching fingers 6 are all directed to a lower side.

In Fig. 7 a preferred embodiment of the invention is shown with a locking ring 1 with different types 6A, 6B, 6C of latching fingers. The first type 6A comprises latching fingers 6 with the greatest length. The second type 6B of fingers comprises latching fingers with a middle length. The third type 6C of latching fingers 6 comprises the fingers 6 with the smallest length. In a preferred embodiment two fingers of the same type are arranged at opposite sides at the ring 1. In a simple embodiment of the invention only two types of fingers with different length are provided. The invention is however not limited to three types of fingers. A person skilled in the art can provide more or fewer types of fingers. The difference in the length between different types of fingers is greater than the different lengths of the same type of latching fingers caused by production ranges. The length of a latching finger could only be precisely produced with a range of length that vary up to 3% of the length. The inventive latching fingers show a greater difference in the length.

In a preferred embodiment of the invention the three types of fingers are arranged at different angles compared to the plane that is determined by the ring 1 as shown in Fig. 8.

Fig. 8 shows a half of the ring 1 of Fig. 7. The first type 6A of fingers is inclined at a first angle $\alpha 1$, the second type 6B of fingers is inclined at a second angle $\alpha 2$ and the third type of fingers 6C is inclined at a third angle $\alpha 3$ compared to the plane of the ring 1. The first angle $\alpha 1$ is greater than the second angle $\alpha 2$ and the second angle $\alpha 2$ is

greater than the third angle α3. All fingers of one type are arranged at the same angle to the plane of the ring.

Figs. 9-11 show different pairs of first and second members, whereby the distance between the stopping plane 14 of the first contact member 2 and the groove 4 of second contact member 3 vary. As a result, the distance between the groove 4 and the ring 1 varies. The different distances are compensated by the inventive different types of fingers and a holding of the second contact member 3 against the first contact member 2 is attained. The result is that the impedance of the connection between the first and second contact member is the same although the position of the groove 4 varies because of high production ranges.

Fig. 9 shows a part of the second sleeve 27 and a part of the sleeve body 24 and a part of the ring 1. For a better understanding of the present invention, three types 6A, 6B, 6C of fingers with different lengths are shown in one plane. They are also positioned to each other at a given angle around the ring 1 as shown in Fig. 6. As shown in Fig. 9 the three different types 6A, 6B, 6C of fingers are positioned at different angles to the plane of the ring 1. Fig. 9 shows an example for a first and second contact member 2, 3 in a mated position with a second sleeve 27 that is adjacent to the stop plane 14. The groove 4 is arranged at a first distance d1 to the stop plane 14. The distance between the groove 4 and the ring 1 is great. In this embodiment the first type 6A of fingers with the greatest length are engaged with the groove 4 and hold the second sleeve 27 against the stop plane 14. In this embodiment all latching fingers 6A,6B,6C are engaged with the groove 4 and hold the second sleeve 27 against the stop plane 14.

In Fig. 10 a second embodiment with a second sleeve 27 and a sleeve body 24 is shown, whereby the axial distance d2 between the groove 4 and the stopping plane 14 is greater than

in Fig. 9. Therefore the distance between the groove 4 and the ring is smaller than in Fig. 9. In this embodiment the second type 6B of fingers and the third type 6C of fingers are engaged with the groove 4 and hold the second sleeve 27 against the stop plane 14.

Fig. 11 shows a third embodiment with a second sleeve 27 and a sleeve body 24, whereby the groove 4 is arranged at a third distance d3 to the end of the second sleeve 27 and the stop plane 14. The third distance d3 is greater than the second distance d2. Therefore the distance between the groove 4 and the ring 1 is small. In this embodiment only the shortest type of fingers 6C are engaged with the groove 4 holding the second sleeve 27 against the stopping plane 14. In a simple embodiment all three types of fingers could be arranged at the same angle.

In order to attain a locking function with little clearance in an axial direction the three types should be inclined with a third angle $\alpha 3$ as it is shown in Fig. 9 for the third type 6C of fingers. For an improved function of holding it is of advantage to arrange the different types 6A, 6B, 6C of fingers at different angles $\alpha 1$, $\alpha 2$, $\alpha 3$, whereby the angles increase with the length of the fingers 6. The different angles have the advantage that the force for mating the first and the second contact member is reduced.

Considering the Figs. 9 to 11 it can be seen that the inventive locking ring 1 with latching fingers 6 with different lengths that are especially arranged at different angles $\alpha 1$, $\alpha 2$, $\alpha 3$ to the plane of the ring 1 provide a locking of the first and second contact member 2,3 with a small axial movement of the first and the second contact member 2,3 for a greater range of distances between the groove 4 on the stopping plane 14.

The ring 1 with the latching fingers 6 is also of advantage for locking pairs of first and second contact members 2,3 with a little axial clearance although the diameter of the second sleeve 27 and/or the diameter of the ring 1 vary in greater ranges of values. A ring 1 may comprise two or more types of pairs of fingers 6 with different lengths.

Reference list

1	locking ring
2	first contact member
3	second contact member
4	groove
6	latching finger
7	first sleeve
8	central conductor
9	outer conductor
11	annular insulator
12	rim
13	opening
14	stopping plane
15	central opening
20	conical flange
21	second annular insulator
22	contacting sleeve
24	sleeve body
25	contacting pin
27	second sleeve
28	unlocking member
29	outer sleeve
30	inner sleeve
32	cable
40	receiving chamber
41	annular flange
42	ring part
43	second outer conductor

Claims

1. Electrical connector comprising:
a first contact member (2) comprising therein a first contact (25);
said first contact (25) is shaped to provide an electrical connection with a second contact (22) of a second contact member (3);
wherein said first contact member (2) further comprises a ring (1) with latching fingers (6);
said latching fingers (6) of the ring (1) are provided for contacting a groove (4) of the second contact member (3) to lock the second contact member (3) with the first contact member (2), when the first and second contact member (2, 3) are in the mated position,
characterised in
that at least two latching fingers (6A, 6B, 6C) have different lengths.

2. Electrical connector according to claim 1 characterised in that the first contact member (2) comprises a stop plane (14), wherein the latching fingers (6) hold the second contact member (3) against the stop plane (14).

3. Electrical connector according to claim 2, characterised in that the latching fingers (6) are shaped and arranged in a way, that the first and second contact member (2,3) have in the mated position a small axial clearance for a movement.

4. Electrical connector according to any one of the claims 1 to 3, characterised in that the latching fingers (6A, 6B, 6C) with different lengths are inclined at different angles ($\alpha 1$, $\alpha 2$, $\alpha 3$) relative to a plane of the ring (1).

5. Electrical connector according to any one of the claims 1 to 4, characterised in that the ring (1) comprises pairs of latching fingers (6A, 6B, 6C), whereby the lengths of the

fingers of different pairs are different and whereby two latching fingers (6A,6B,6C) of a pair are arranged at opposite sides of the ring (1).

6. Electrical connector according to any one of the claims 1 to 5, characterised in that at least two types of latching fingers (6A,6B,6C) are arranged, that each type has a different length, wherein the three types of fingers are arranged at three different angles ($\alpha 1$, $\alpha 2$, $\alpha 3$) with respect to the plane of the ring (1).

7. Electrical connector according to any one of the claims 1 to 6, characterised in that the latching finger (6C) with the shorter length is arranged at a smaller angle ($\alpha 3$) relative to the plane of the ring (1) than the longer fingers (6A, 6B).

8. Electrical connector according to any one of the claims 1 to 7, characterised in that the first contact member (2) is realized as a coaxial plug having an inner and an outer conductor (25,7).

9. Electrical connector according to any one of the claims 1 to 8, characterised in that the second contact member (3) is realized as a coaxial jack having an inner and an outer conductor (22, 27), wherein the groove (4) is arranged at an outer side of the outer conductor (27).

10. Electrical connector system comprising an electrical connector according to claim 1 and a second contact member (3) having a second contact (22) and a groove (4), wherein the first contact (25) is mated with the second contact (22) and the first and second contact member (2, 3) are held by the latching fingers (6) in the mated position.

Abstract

Electrical connector with a locking ring, especially a coaxial plug

The present invention relates to a electrical connector comprising a first contact member comprising therein a first contact, said first contact being shaped to provide an electrical connection with a second contact of a second contact member, wherein said first contact member further comprises a ring with latching fingers, said latching fingers of the ring are provided for contacting a groove of the second contact member to lock the second contact member with the first contact member, when the first and second contact member are in the mated position, characterised in that at least two latching fingers have different lengths.

Figure 1

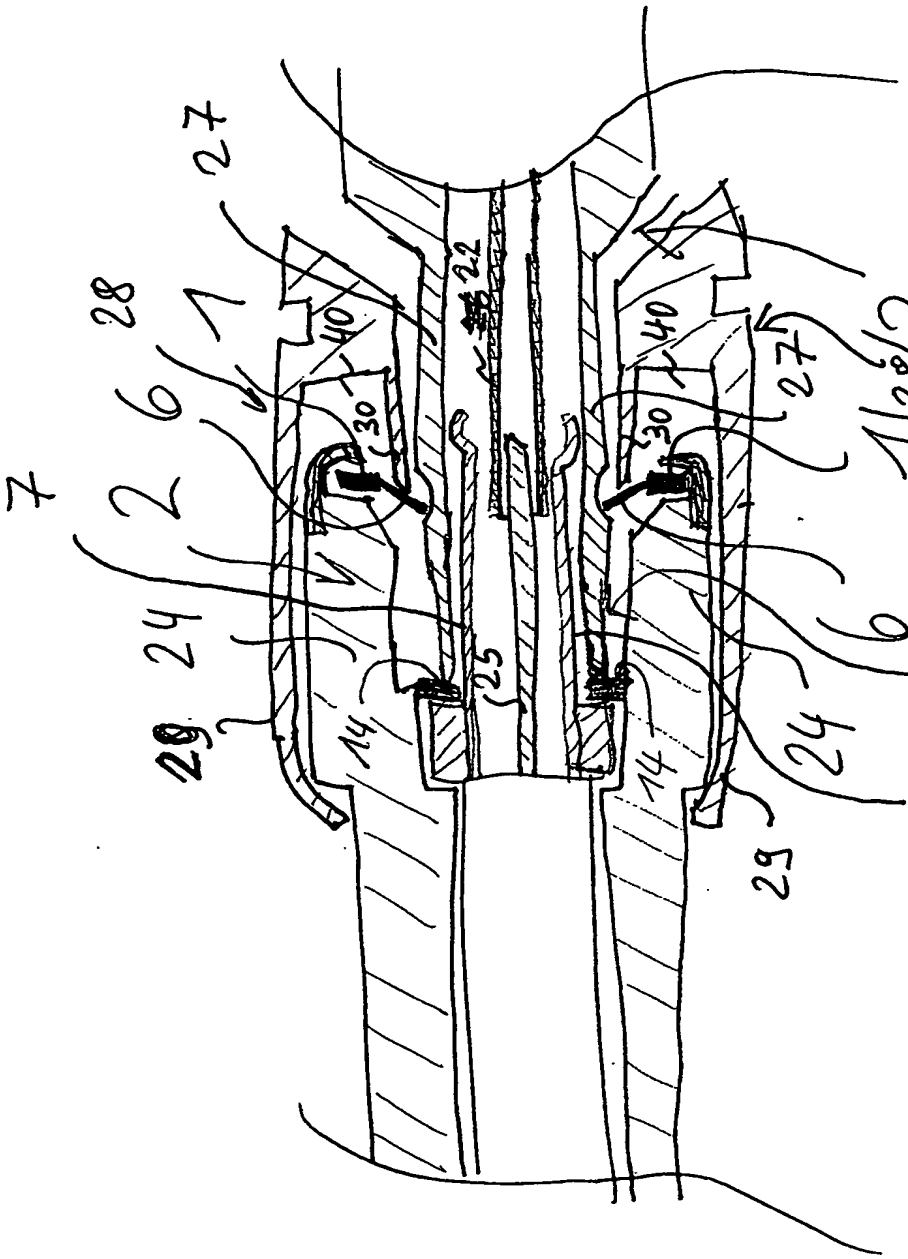

Fig. 1

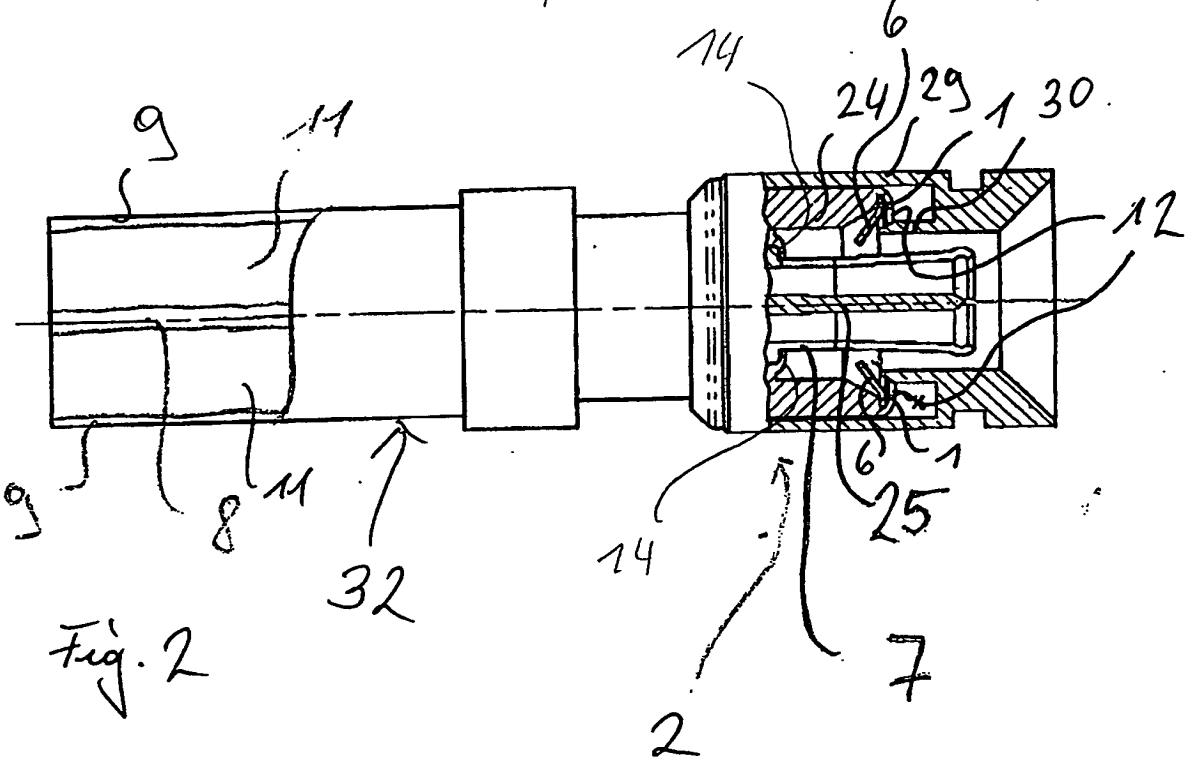

Fig. 2

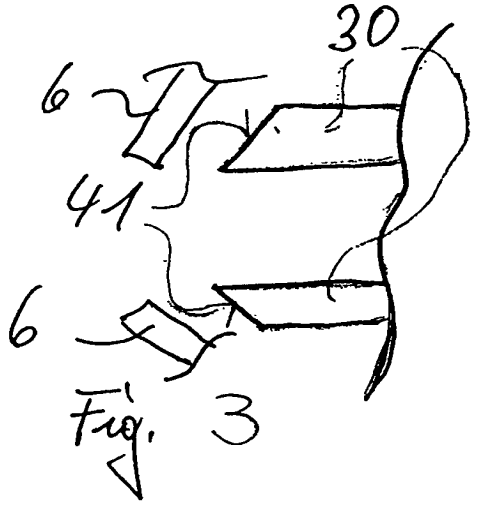

Fig. 3

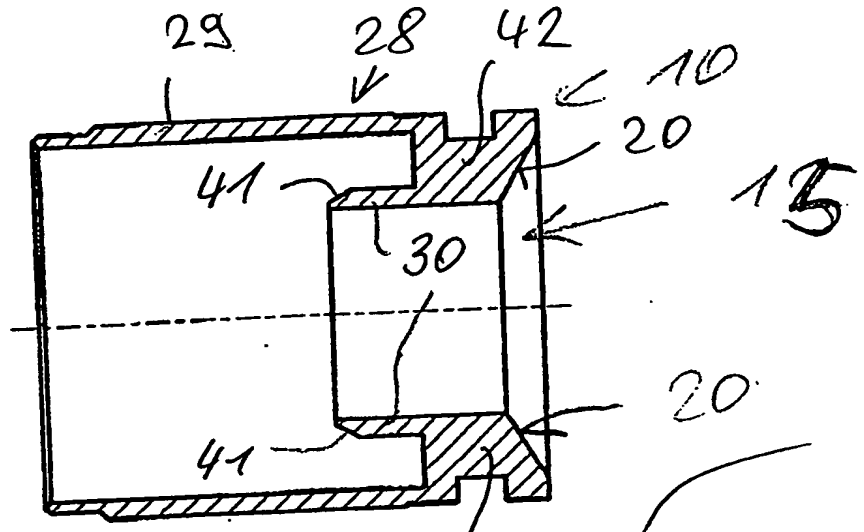

Fig. 4

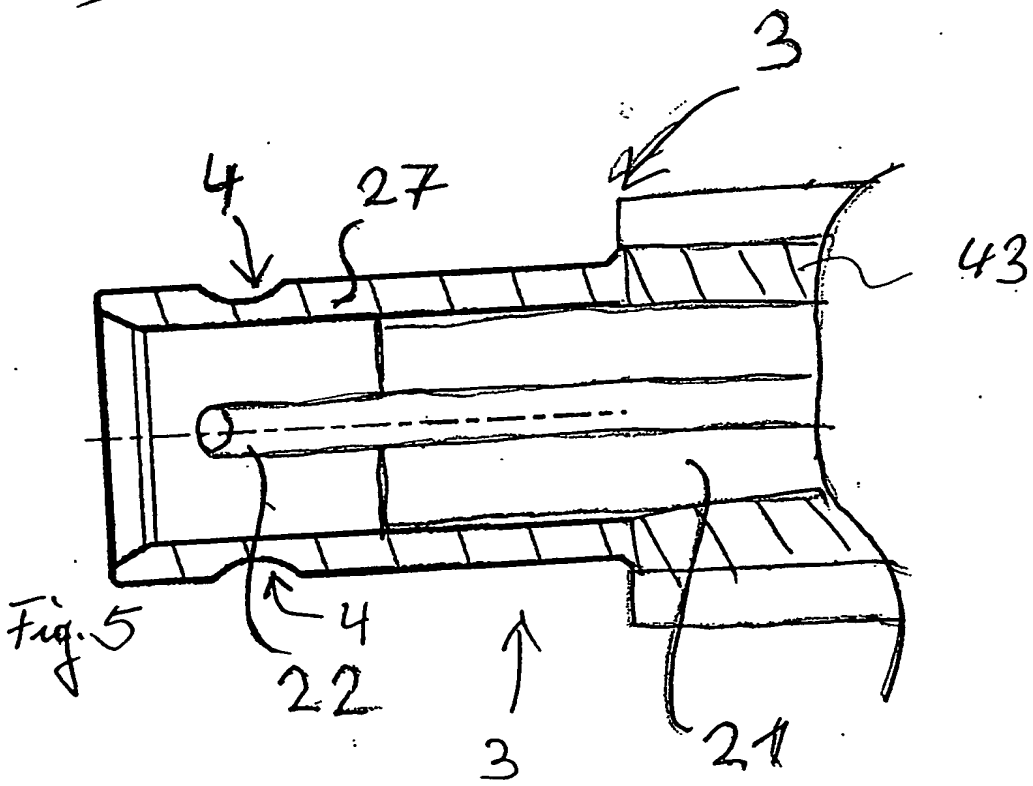

Fig. 5

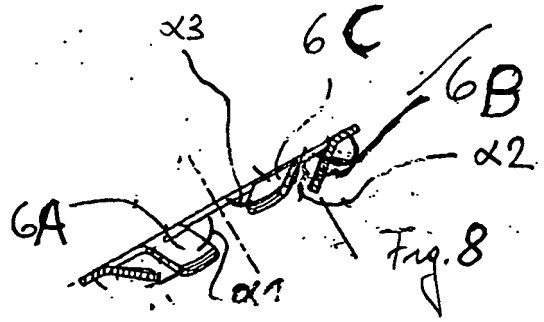

Fig. 8

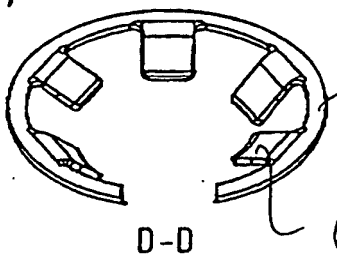

Fig. 6

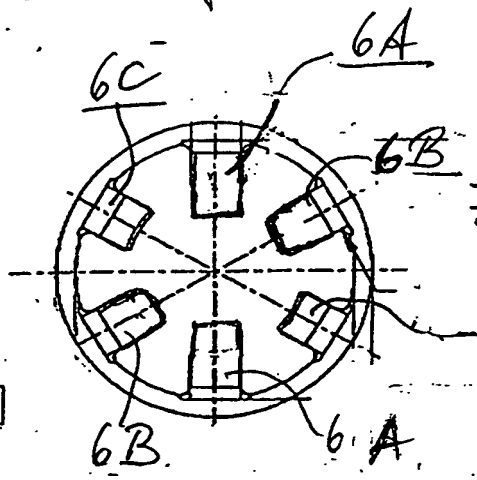

Fig. 7

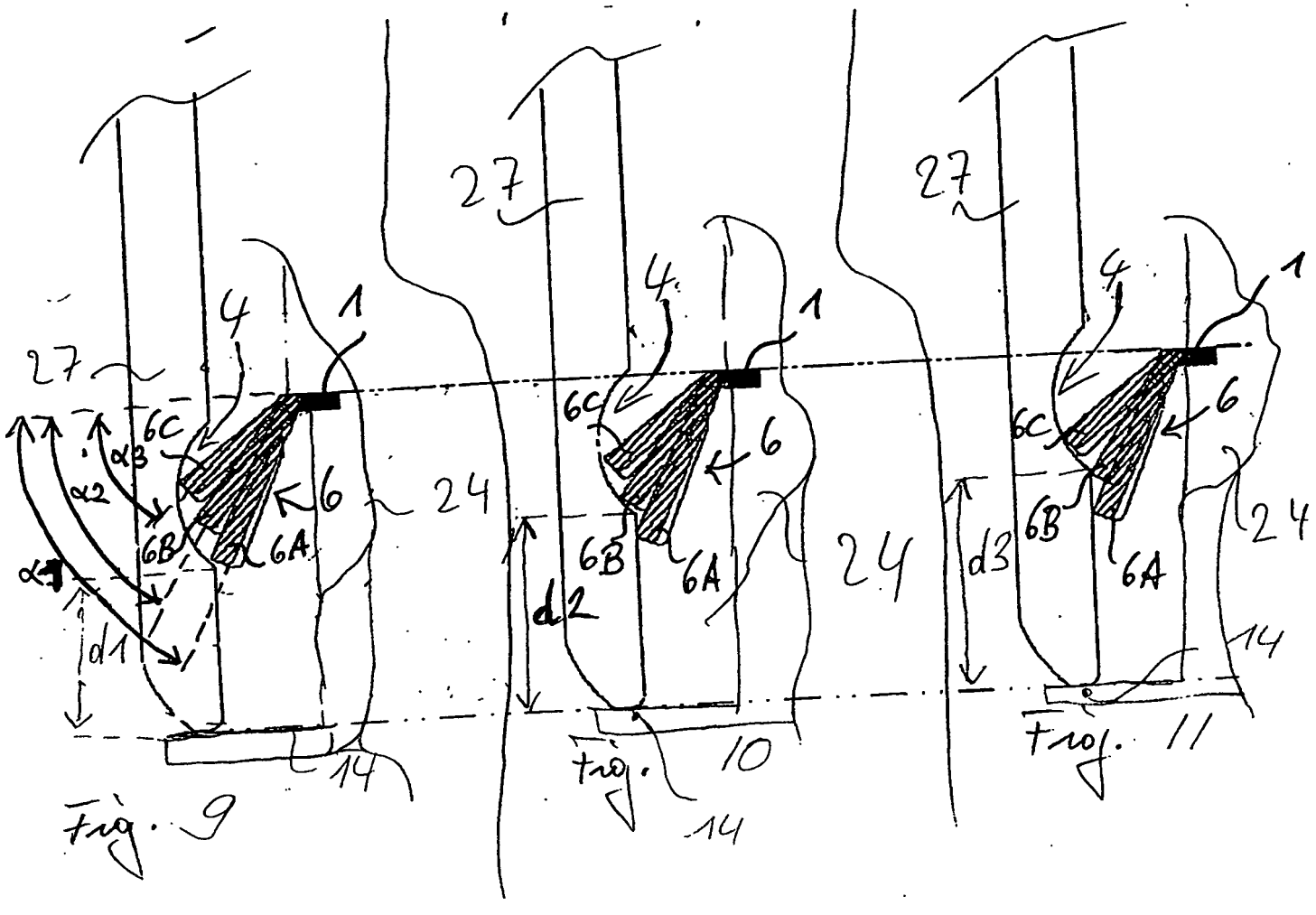

Fig. 9

Fig. 10

Fig. 11